UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF AGRICULTURAL ECONOMICS

Operations Guidance Report on

BIG MALAD SEGMENT OF

MALAD RIVER WATERSHED

ONEIDA COUNTY, IDAHO

WATER UTILIZATION SECTION
DIVISION OF LAND ECONOMICS

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Under the Provisions of the
Water Facilities Act
(Public Law No. 399, 75th Congress)

October 1939

BUREAU OF AGRICULTURAL ECONOMICS
Washington, D. C.

MEMORANDUM

To: Mr. M. M. Kelso, Head,
Division of Land Economics.

Dear Mr. Kelso:

The attached Operations Guidance Report on the Big Malad Segment of Malad River Watershed, Oneida County, Idaho, has been prepared by Water Utilization personnel including Mr. E. L. Beckstrom, Assistant Hydraulic Engineer, and Mr. Ray Deschamps, Junior Economist, working under the direction of Mr. John S. James, District Water Utilization Supervisor.

The results of previous investigation by Mr. J. Winter Smith, Associate Hydraulic Engineer, were used, as was the work of the engineers of the Soil Conservation Service, in charge of Mr. A. W. McCulloch and Mr. Robert Leep, Area Engineers, under Mr. Merritt V. Penwell, Area Conservationist at Pocatello, Idaho.

Very truly yours,

Homer M. Wells

Homer M. Wells, Acting in Charge,
Water Utilization Section,
Division of Land Economics.

Attachment

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BIG MALAD SEGMENT

MALAD RIVER WATERSHED

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SUMMARY AND CONCLUSIONS

The Big Malad Segment of Malad Valley includes about 50,000 acres of which about 7,000 acres are under irrigation. About 6,000 acres are served through the water rights and works of Samaria Irrigation Company. The water supply is from the Big Malad River, the principal source of which is Big Malad Spring. Water supply is inadequate to provide full irrigation for all lands served by this company.

Generally in Malad Valley the water supply for higher lands is deficient, while an excess of water is concentrated in the lower part of the Valley. Any facility or adjustment in use which tends to hold back water from the lower lands for use in the upper part of the valley is of public benefit in the better use of land and water. Such public purpose could be served and an additional effective supply for the Samaria Irrigation Company can be obtained by storage of the winter flow of Big Malad River. Such storage can be provided to the extent of approximately 1,200 acre feet by construction of a dam on Big Malad River at approximately the location known as Site No. 4.

The reservoir would be subject to some percolation losses, but even so it would probably be filled every year before the beginning of the irrigation season. It can also be refilled to the extent of about 200 acre-feet each year. Thus this reservoir would make available about 1,400 acre-feet of water to supplement the natural stream flow during the irrigation season.

Percolation from this reservoir would feed the ground water to the benefit of land owners and water users including some of the stockholders of the Samaria Irrigation Company and others outside that company. The extent and distribution of such benefits are indeterminable and therefore these values could be considered in offsetting costs of the reservoir only as among the intangible general public benefits resulting from such development.

Preliminary estimate of cost of such storage reservoir is $44,000. It is recognized that unforeseen contingencies may increase the eventual cost to a greater amount. Should such actual cost exceed $50,000, it would be necessary that the amount in excess be procured by the Irrigation Company from other than Federal funds.

Permissible or practicable annual cost to the Samaria Irrigation Company for additional water, is probably not greater than $2.50 per acre-foot. On a basis of repayment amortized over 20 years at 3 percent this would provide with some allowance for "coverage" for construction cost of about $36 per acre-foot. For 1,400 acre-feet, this would indicate a limit of about $50,000

which the water users should be expected to repay under such terms. Under other terms of repayment the reimbursable cost would vary from $30 per acre-foot for a 15 year loan to $55 per acre-foot for a 40 year loan at 3 percent. Under terms of 40 years without interest, the capital cost could be $100 per acre-foot. Some additional cost may be justified as a public contribution in grant or subsidy in recognition of intangible general benefits. Such grant should not exceed the amount necessary to bring the annual repayment charge within the net value to the water users, herein estimated to approximate $2.50 per acre-foot. If any such subsidy is required, its amount will depend, in part, on the terms of repayment adopted. Consideration of the preliminary cost estimate indicates that it would be unlikely to exceed 20 percent of the total cost. Within this amount such grant would appear to be consistent with indicated public policy.

RECOMMENDATIONS

It is recommended that operations proceed on the Big Malad Segment, Malad River Watershed, such operations to consist essentially in the construction of a dam and storage reservoir on Big Malad River at approximately the location known as "Site No. 4 or Site No. 5" in Section 15 or 16, Township 14 South, Range 35 East, subject to the following provisions and limitations:

(1) That detailed studies, design and estimate, show that a storage capacity of approximately 1,200 acre-feet can be obtained for a construction cost not greatly in excess of $50,000, and that such studies confirm present indications that leakage will not be excessive.

(2) That repayment contracts satisfactory to the F.S.A. can be obtained, for repayment of the construction costs of such a reservoir, and that repayment contracts based on sound farm plans be obtained by F.S.A. for repayment of the construction costs of the reservoir less any grants found justifiable, but that annual payments by the water users shall not exceed approximately $2.50 per acre-foot of the estimated annual output.

(3) That any cost in excess of $50,000 be provided by the water users from other than Federal sources.

PURPOSE AND SCOPE

Malad River Watershed was approved by the Water Facilities Board for planning and the Big Malad Segment for operation, at Portland, Oregon, September 28, 1938, and as amended on December 12, 1938.

At a conference of the cooperating agencies at Boise, Idaho, on September 16, 1939, the Bureau of Agricultural Economics was requested and agreed to prepare a guidance report for operations on the Big Malad Segment.

The principal features presented appear to be, (1) Physical determinations as to practicability of constructing a storage reservoir on Big Malad River, and (2) Economic determinations relating to allowable unit costs for supplemental irrigation water to be provided by the proposed reservoir.

This report is intended primarily to indicate conclusions in regard to these two questions. There is included in somewhat summary form, data and discussions leading to these conclusions. General description of the area is given briefly as a background.

Present consideration for operations is confined to the proposed construction of a storage reservoir on Big Malad River for the Samaria Irrigation Company.

I

DESCRIPTION OF AREA

Location

The Big Malad Segment includes only a small part of the western side of Malad Valley in Oneida County, Idaho. It comprises that part of the valley which is drained and served by the Big Malad River lying mainly in Townships 14 and 15 S., Range 35 E., B. M., but also includes a small area in the southwestern corner of T. 15 S., R. 36 E. The total area concerned is about 50,000 acres, of which about 7,000 acres are irrigated. (See Map 1.)

The drainage heads in the vicinity of Big Malad Spring. The Blue Springs Hills form the western divide, and Little Malad River is taken as the eastern boundary since the water of Big Malad River serves the entire irrigated area between the two streams. The southern extremity of the area reaches the south line of sections 9 and 10, T. 16 S., R. 35 E., B. M.

Climate

Based on a twenty year period of record, the annual precipitation at Malad averages 16 inches, of which nearly 40 percent normally occurs during the growing season. During winter, precipitation is chiefly in the form of snow.

Temperature seldom falls below -25° F. The highest temperature recorded is 108° F. The average length of growing season is 114 days, minimum 93 days, and maximum 136 days.

Culture

Transportation facilities consist of graveled county roads that are numerous within the area. About seven miles distant at Malad is available a branch line of the Union Pacific Railroad, and U. S. Highway No. 191. Also at Malad are located two flour mills, one dairy products plant, and one cooperative plant for handling eggs that process farm produce for local and export trade. There are available adequate church, school, power, and telephone facilities in the area.

Topography

The Blue Springs Hills and remnants of the old Lake Bonneville terraces provide topography of rather high relief to the western and southwestern borders of the area. The foothill slopes commence about a mile west of the Big Malad River along the west side of the area about $2\frac{1}{2}$ miles south of Samaria Lake. The rougher land, with land slope gradients of 50 feet or more to the mile in the vicinity of Big Malad Spring in the northern extremity of the area, gradually levels off to the east and south where the land slope gradients drop to about 20 feet or less to the mile.

Near the Big Malad Spring the River has cut its channel deeply into the alluvium, estimated at approximately 45 feet. The channel gradually becomes less defined and near Samaria Lake is but a few feet below the surrounding valley land. Below this point Malad River is a slow and meandering stream. Nearly all land, with the exception of that immediately adjacent to the river, is tillable and readily irrigable.

Soils

In the upper or northern portion, the agricultural soils are situated mainly on gently sloping terraces and are generally well drained. Big Malad River has cut its channel through the terrace and has formed a narrow strip of river bottom land, seldom more than one-quarter mile in width. In the area of low gradient, soils are usually heavier and are poorly drained.

Soils have been formed under many conditions, but are generally quite mature and their characteristics are fairly stable. They were developed principally from lake-laid old valley filling material, recent alluvial material, and stream-laid old valley filling material. Of minor importance are soils that have developed from loessial, footslope, and miscellaneous material. In texture, the agricultural soils range on the surface from a silty clay loam to a gravelly fine sandy loam. The upland soils are usually low in organic matter.

Geology

Malad Valley is considered by many geologists to be of structural origin. Whether it is a graben produced by black faulting, or a simple fault valley produced by thrust or normal faulting has not been indisputably determined. These, and other, types of faulting are present in the regional vicinity of Malad Valley. The exact location of the fault plane within the valley has not been definitely established, but its probable presence has been of signal importance in considering the feasibility of storage sites at various locations in the valley. Excessive leakage in the Elkhorn Reservoir, about 7 miles north of Big Malad Spring, in Section 7, T. 13 S., R. 35 E., as well as the flow of Big Malad Spring, have been partially attributed to this fault. At the site of Big Malad Reservoir, located about 1 3/4 mile south of Big Malad Springs, there is no evidence of surface faulting.

Paleozoic limestones, some sandstones, and quartzites mainly of the Wells formation, compose the Blue Springs Hills which form the west flank of the valley. The ancestral valley, once occupied by Lake Bonneville, has been partly filled with recent alluvium which is of both lacustrine and fluviatile origin.

The lacustrine material which is a predominantly clayey silt makes up the major part of the sediments, while sands and gravels deposited largely in the form of alluvial fans are particularly abundant along the west margin of the valley and have been encountered by wells at various horizons in the valley fill.

Land Use

Irrigation in this valley has been practiced for over 75 years. The town of Samaria located within the Big Malad River Segment is one of the oldest settlements. The low lands were the first to be irrigated due probably to the ease in which water diversions could be made and also because wild native hay produced on the low lands was essential for livestock. As more intensive farming developed cultivation gradually extended up the valley to include the most productive lands. Irrigation from streams became well stabilized and for the most part was under the control of four mutual irrigation companies, each of which utilizes the available water from one of the four principal streams. The Samaria Irrigation Company controls the flow of the Big Malad River and is the only company under consideration in this report.

Artesian wells were found practical in approximately the lower half of Big Malad Segment, and for many years have been important in irrigating grass meadows. It is estimated that there are now approximately seventy-five wells in this section some of which have ceased to flow.

Outside of the permanent native hay pasture the greater portion of irrigated crop land is utilized for production of alfalfa hay and grain cereal crops. Minor crop enterprises on the irrigated land are cash grain, alfalfa seed, and sugar beets. On

the tillable bench land, where it is impractical to irrigate, dry land wheat farming is practiced under a summer fallow system. The hills and mountainous areas adjacent to the Valley are used for spring and summer grazing. Nearly all the hay, and a large percent of grain crops are fed to range cattle or dairy cows. Minor livestock enterprises are poultry and range sheep.

The majority of operators have not more than 160 acres of irrigable upland, the best soils of which will yield approximately as follows:*

	Average per acre yield under irrigation	Average per acre yield dry land
Alfalfa Hay	3 to 4 tons	1 to $1\frac{1}{2}$ tons
Wheat	40 to 50 bu.	10 to 25 bu.
Barley	45 to 70 bu.	15 to 40 bu.
Sugar Beets	15 to 25 tons	______

*This estimate is the result of conversations with local operators and agricultural experts of the Soil Conservation Service and Farm Security Administration.

Water Use

Of the 7,000 acres irrigated in the Big Malad Segment, about 6,000 acres are under the system of the Samaria Irrigation Company. For much of this latter area the Samaria water supply is supplemented from other sources, one being Little Malad, others being small individual spring rights, and for about the lower third of the tract, the flow of artesian wells. There are two pumped wells one of which is used entirely to supplement indivi-

dual supplies and from the other some water is sold to the Samaria Company.

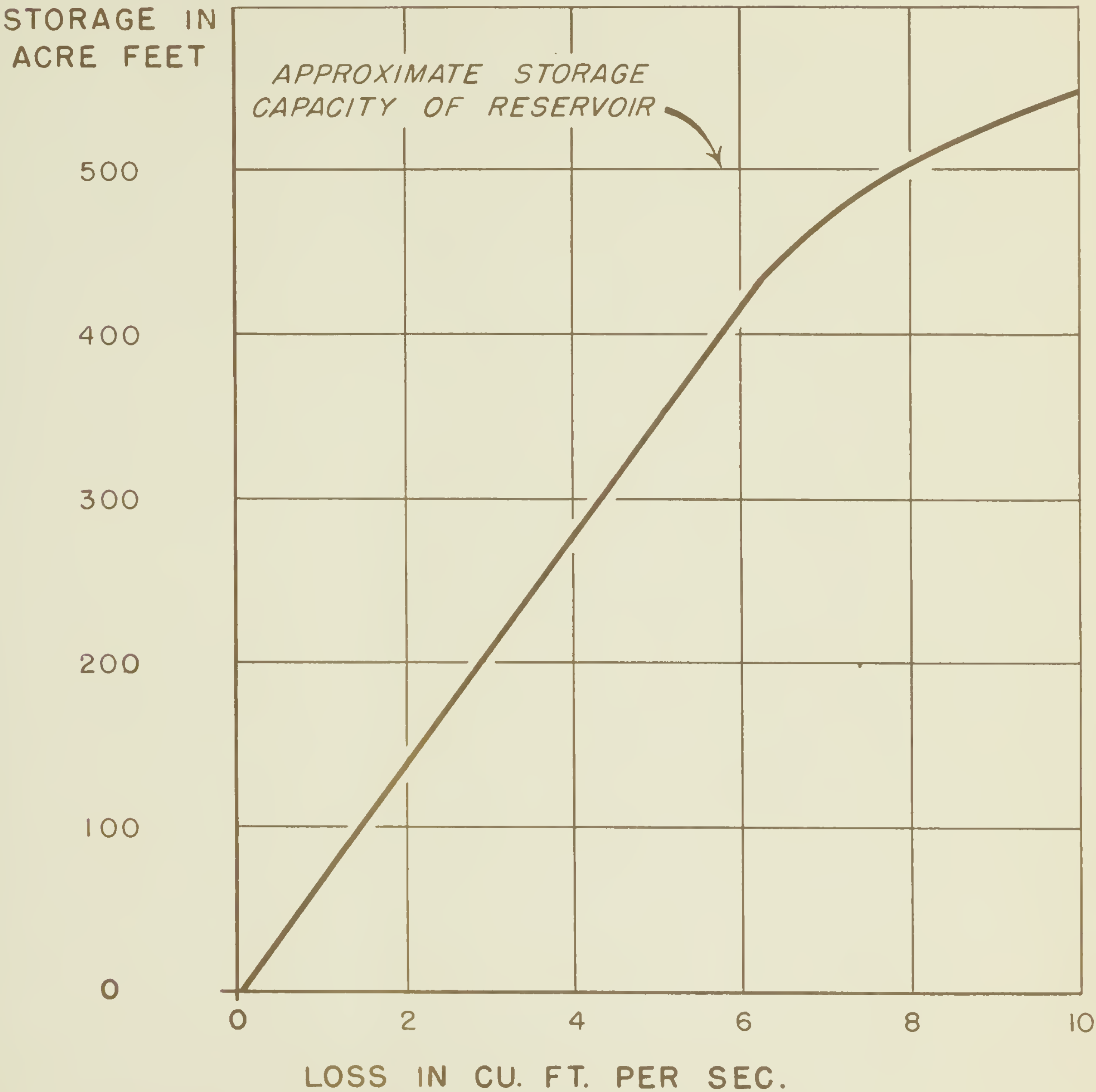
Water supply for the Samaria Irrigation Company is derived principally from Big Malad Spring. This flow is fully used during the irrigation season. By construction of the Big Malad Dam about 1915, about 500 acre-feet of storage space was provided to conserve winter flow and that of short periods during the summer when demand for irrigation is low.

This structure has not given good service. Due to lack of a spillway or other causes it has failed at least once. A further unsatisfactory feature is found in excessive percolation loss from the reservoir basin. This loss has been found practically to equal the supply when the reservoir is full. From records made, December 1, 1938, to July 1, 1939, of inflow, outflow and gain or loss of storage, a generalized curve has been developed which shows, as nearly as it can be determined, the loss from this reservoir in relation to the amount of water in storage. This is shown on Chart 1 herewith.

Surface Water Supply

Due to the lack of adequate discharge records on Big Malad River, it is difficult to make a reliable analysis of the flow of this stream. On the basis of a number of measurements from various sources at irregular intervals between 1931 and 1939, the flow has

INDICATED LOSS FROM BIG MALAD RESERVOIR IN RELATION TO STORAGE IN RESERVOIR



AVERAGE STREAM FLOW BIG MALAD RIVER 8 CU. FT. PER SEC.

been rated from 4 to 23 cubic feet per second at various times, and the average annual discharge before 1939 has been estimated to approximate 8 cubic feet per second.

Since Big Malad River has a very small surface drainage area, approximately 7 square miles, and its flow is provided almost entirely by the discharge of Big Malad Spring, the stream normally shows less seasonal fluctuation than most other streams of the valley. However, there appears to be a definite and appreciable increase in the discharge of Big Malad Spring as a result of storage in the Elkhorn Reservoir located about 7 miles up the valley on Little Malad River. This Spring is located in a natural depression about 100 feet lower than the terrain immediately surrounding it, and as much as 50 feet lower than most of the land lying north and east of it along Little Malad River. Under these conditions it seems quite reasonable that at least part of the water lost from the Elkhorn Reservoir may flow through the alluvium toward Big Malad Spring. There is also the possibility of a fault channel connection between that reservoir and the spring. Although there is no apparent surface indication of the existence of such a channel, this possibility is substantiated to some extent by the fact that the water from the spring is 10 to 15 degrees warmer than that of the average shallow spring and that a longitudinal fault probably contributed to the formation of the valley.

On March 30, 1939, due to unusually rapid run-off from the upper portions of the Little Malad River drainage, the water level

of the Elkhorn Reservoir reached an all time high of 32 feet. At this time the discharge of Big Malad Spring was recorded at 13.66 cubic feet per second. From this date, the discharge of the spring increased steadily to a peak of 22.5 cubic feet per second, on May 8, and maintained this rate of flow to May 19 when it began to decrease. Part of that increase may be attributed to high seasonal run-off and its ground water increment, but considering the character of the drainage area, it seems almost certain that a large part of the flow must have been contributed from the Elkhorn Reservoir losses.

Warm Springs, about 9 miles south of Big Malad Spring, also contributes to the water supply of the southern part of the area. Records of this discharge are even less conclusive than those of Big Malad Spring. The flow is reported by officials of the Samaria Irrigation Company to average about 5 cubic feet per second. On this basis it provides about 1,800 acre-feet of water during the irrigation season.

Extensive records from December 1, 1938, to July 1, 1939, on the discharge of Big Malad Spring and the water delivered from the Big Malad Reservoir, provide the bases for three significant conclusions. First; the flow of the spring was considerably greater during the period of observation than had been reported previously for a corresponding period. Second; the increased discharge recorded appears to be related to increased storage in the Elkhorn Reservoir, and third; the storage losses in the Big Malad Reservoir when full were almost equal to the inflow.

Summarizing available reports, records and analyses, it appears that the principal water supplies of the Samaria Irrigation Company are Big Malad and Warm Springs which total approximately 13 cubic feet per second. During an irrigation season of 195 days this would amount to about 4,900 acre-feet. Winter flow is now available for use only to the extent of the storage effected in Big Malad Reservoir, amounting to about 500 acre-feet. The entire off-season flow of Big Malad Spring is potentially available if storage can be provided. This amounts to approximately 2,700 acre-feet.

II

NEED OF DEVELOPMENT

Malad Valley is typical of the better valleys of the Rocky Mountain Region. From its relatively abundant resources for the first settlers a foundation of prosperity was built although the area still supports the community, increasing population and changing economic conditions have increased the demand on these resources, requiring more full and conservative use.

As in most similar valleys, water for irrigation is the first concern, and the amount of it available for effective use, largely measures the limit of agricultural development. In the Big Malad Segment, the principal water supply for some 6,000 acres is approximately 5,000 acre-feet from Big Malad River. Even though this is supplemented from other sources, it is still obviously insufficient for the land served.

This need for additional water was recognized by the Water Facilities Board in approving the Big Malad Segment for operations under the Water Facilities Act.

III

PROPOSED FACILITIES

To meet the need for additional water in the Big Malad Segment it has been proposed to provide storage for the winter and excess summer flow of Big Malad River. It was originally considered that this might be accomplished by the reconstruction and enlargement of the present Big Malad dam. Excessive percolation losses from this reservoir have removed this from consideration.

Other sites for such storage structure and the physical and economic factors affecting proposed construction are briefly discussed in the following pages.

IV

PHYSICAL CONSIDERATIONS IN DETERMINING PRACTICABILITY OF STORAGE DEVELOPMENT

Probable Water Losses and Water Supply

The silt, at the site of the Big Malad Dam in Section 22, T. 14 S., R. 35 E., while of fine texture, appears to have poor colloidal properties, and is relatively porous for material of this type. It also has characteristic joint or cleavage planes, and it fractures along these planes into more or less rectangular blocks. In its undisturbed condition this silt apparently absorbs water readily, and permits heavy leakage through joint cracks. These cracks enlarge as the water continues to percolate through them into the more permeable underlying sands and gravels. The cracks occur prominently in the reservoir basin and probably were developed largely by shrinkage in the drying process after saturation as the water in the reservoir was depleted. This explanation seems to be confirmed by the fact that most of the cracking occurs along the sides of the reservoir basin, a short distance below the high water line where alternate saturation and drying occur most frequently. At the locations of proposed dam sites #4 and #5 which are in the basin of the present Big Malad reservoir, the jointing appears to be less pronounced, and no cracks are apparent at the surface.

When pulverized and compressed, the cohesion of the silt increases and no cracks have developed in the present dam fill. Mr. Thompson's[1] experiments indicated that the silt will slump naturally to a slope of about 3:1 when it becomes saturated. Mr. Thompson has submitted the following mechanical analysis of the silt found at the present Big Malad dam site:

51.4% less than 0.01 mm. diameter

38.9% 0.01 to 0.05 " "

9.3% more than 0.05 " "

Test pits and wells in the vicinity of both the present and proposed dam sites have shown the ground water gradient to be in a southeasterly direction from the reservoir. While no test wells were drilled at either sites #4 or #5, well #2 on the west side of the reservoir, and the nearest of the wells to site #5 was a dry hole to a depth of 115 feet, and auger holes on the east side of the reservoir near this site were also dry when examined on July 1, 1939. However, the water level in the reservoir was very low at the time.

From a geological aspect, there seems to be little choice between sites #4 and #5, and either appears preferable to the present site.

In contemplating the construction of a dam at one of the proposed sites, the possibility of avoiding losses such as those occuring

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1 Thompson, David G., and Farris, R. W., "Preliminary Report on the Water Resources of Malad and Curlew Valleys, Oneida County, Idaho;" U. S. Geol. Sur. in cooperation with Idaho State Dept. of Reclamation, April 1932, pp. 97.

in the present Big Malad reservoir is the primary consideration. While surface and subsurface investigations indicate that losses from the proposed sites, number 5 and 4 located about 2,000 and 4,000 feet, respectively, up stream from the present dam, may be expected to be materially less, it is impossible to make any reliable quantitative estimate in this respect. With proper design and construction, loss through the dam itself should be negligible. Since no areas of leakage are now apparent in the proposed reservoir basins, serious losses are not anticipated from this source. However, some loss will undoubtedly occur, and experience with the present reservoir indicates that greater than normal loss may be expected. Loss per unit of storage capacity can reasonably be expected to be reduced as much as 75%, but the gross loss can be reduced much less than this because of the increased capacity of the reservoir. The present gross losses can possibly be reduced 45% by constructing a dam at either of the proposed sites. Losses from storage during most of the storage season of 1939 averaged about 7.0 cubic feet per second, which amounted to approximately 2,500 acre-feet for this period. If 45% of this loss could be eliminated, about 1,100 acre-feet additional water would be available for storage which was lost in accumulating about 700 acre-feet of effective storage in the season of 1939.

There is estimated to be 2,700 acre-feet of water normally available for storage during the non-irrigation season in addition to that required for stock use. Even with the anticipated saving of

nearly half the present percolation losses, it appears that provision of much more than 1,200 acre-feet of storage can hardly be justified.

Since water consumption decreases considerably during the haying season, a brief storage period occurs during that time in which 200 to 300 acre-feet of storage may accumulate. Other brief periods of storage may also occur. In this way, a reservoir of 1,200 acre-feet capacity should actually provide 1,400 or 1,500 acre-feet of effective storage.

On these bases, the construction of a reservoir of 1,200 acre-feet capacity appears justifiable as far as the question of water supply is concerned. Without the operation of the Elkhorn Reservoir and in some "dry years," a reservoir of much larger capacity probably could not be filled.

Cost of Storage

A preliminary estimate indicates that a dam could be constructed at site number 4[1] to impound 1,200 acre-feet and deliver 1,400 acre-feet of water at a cost of about $44,000, or $31.43 per acre-foot.

At site number 5, a dam to impound 1,600 acre-feet of water and to deliver 1,800 acre-feet has been estimated to cost about $57,000 or $31.67 per acre-foot. The larger reservoir therefore

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[1] See Map 1.

shows no advantage in unit cost. Construction material, particularly gravel, is also more readily available at site No. 4. The smaller structure required will also reduce the problems of design.

Other sites have been suggested about 9 miles below the present Big Malad dam, the most favorable being the Pleasantview road site. The estimated storage cost for 1,200 acre-feet at this site is $28.00 per acre-foot. However, as a pumping lift would be required in delivering water to canals the cost per acre-foot compares unfavorably with the upper sites.

Feasibility of Construction

The silt, largely available for construction of an earth fill, shows an apparently high permeability and tendency to shrinkage cracks in its natural deposits. However, such cracks are not apparent in the present dam and a uniform permeability though high will not preclude its use in a stable structure. It also appears from the mechanical analysis that the addition of a very small percentage of colloidal material might make a very impervious mixture. Addition of sand and gravel will lessen tendency to cracking. With design controlled by laboratory test, it is believed a satisfactory earth fill can be constructed at this location.

Groundwater Consideration

Of the total loss from storage in the Big Malad Reservoir, evaporation loss probably constitutes less than 50 acre-feet and

the remainder is added to groundwater storage. Cross sections prepared from well data indicate the highest groundwater gradient to be in a southeasterly direction from the reservoir toward Devil Creek and Little Malad River.

The increase in groundwater from the operation of the reservoir will be most noticeable in the area southeast of and near the dam, but will be effective over an area of about 20,000 acres, 12,000 of which lie within the confines of the Big Malad Unit. This increase will not be evenly distributed, however, because wells and springs near the reservoir will have slightly increased flows which will reduce the hydrostatic head which would otherwise develop over the entire area. The approximate area of this probable influence on groundwater is shown on the accompanying map.

These reservoir losses will not actually be entirely a net addition to the groundwater storage since large stream losses which now occur along a three mile section below the present dam, and replenish groundwater supply, will be largely eliminated during the operation of the dam.

Under the present use of water within the valley, the net appreciable benefit of the additional groundwater may not be great and will accrue to a relatively small proportion of the land holders within the project area since the groundwater increment may be largely dissipated in the waste flow from wells in the lower part of the valley, both within and outside the irrigation district. In any case such benefits will be indeterminable both as to amount and distribution. They are therefore intangible and may be considered in relation to cost, only as part of the public benefits.

V

ECONOMIC CONSIDERATIONS IN DETERMINING VALUE OF STORAGE DEVELOPMENT

Comparative Value of Non-irrigated Land and Irrigated Land

As previously indicated under the heading "Land Use", hay and grain crop yields are more than doubled when put under irrigation. Likewise, land values on land that includes a good water right are more than double the value of non-irrigated land. Land values for irrigated land range from $50 to $100 per acre depending upon available water, soil, and location.

Although irrigation materially increases crop yields and approximately doubles land values it is still very difficult to relate the actual value of water on a per acre foot basis with the increased value of land without a record of individual operations. Not only do such factors as changes in farm enterprises, operating costs, land values, taxes, etc., enter, but there is also the factor of present use or amount of water applied per acre that cannot be estimated without completed records. To receive the most effective use from water available and also to attain the greatest net profit from their land, most operators find it practical to apply a small amount of water which will produce a fair crop, rather than utilize the same amount of water on a smaller acreage to produce a maximum yield. Other operators, due to their farm organization set-up might find it advantageous to apply sufficient water to receive the maximum in crop production.

Available Information on What Operators are Paying per Acre Foot for Present Supply of Water

In ascertaining a value per acre foot for present irrigation water that is used, the four irrigation companies in Malad Valley were considered. As there is no conclusive evidence on value per acre foot, it was assumed that an estimate made from statistics concerning all companies would be more representative than if statistics from one company were used. The fundamental difficulty in determining value per acre foot is due to meager information available on actual stream flow, or the amount of water represented by one share of stock in any company. In addition, no records are available on transmission loss in delivery or on return flow of water which would represent re-use.

The most accurate indication of water value which represents the upper limit that operators will pay for water under the present type of farming is the amount per acre foot that operators are now paying for water pumped from wells and delivered to the regular stream flow. Two pumped wells deliver water to irrigation companies. This water is delivered to distribution systems at approximately $2.50 per acre foot at the pump where it is diverted into the regular stream.

Another significant factor in determining water value is expressed by what use is actually being made of these pumping plants. Out of six wells that in 1937 showed operating costs ranging from $1.28 to $3.08, during the summer of 1939 one did not operate due to excessive cost and owners of another well questioned the practibility of continuing operations.

Although operators are actually paying about $2.50 per acre foot for pumped water delivered to the regular stream, this amount does not indicate an accurate value of water. As no water measurements are available on stream

flow and pumped water is added to the regular stream flow, there is no way of knowing what proportionate contribution the pumped water has made. For this reason the value of an acre foot of pumped water for general crop production can not be accurately estimated until either stream measurements are known or pumped water is used exclusively. Although the present price paid for pumped water is not an accurate indication of value, it still remains apparently the best indicator available.

The above price of $2.50 per acre foot appears to have been paid without distress, while higher prices for water may have been paid there is evidence that such higher prices may reflect in part forced or "distressed" values. Due to increasing population the greater demand for water may increase its cost to the point where many farms are no longer profitable. When a farm is subdivided for younger generations until it becomes marginal in production, the operator is then confronted with the decision of whether to quit and sell out or to remain and compete by expanding his business. His natural inclination is to remain and although there might be several ways in which to expand business the fact remains that where irrigation has always been one of the most important factors in farm operations, irrigation development will appear to be the logical means of expansion. To get water he will pay a price that is higher than it is worth to the average farmer. He might pay a higher price for water than its actual productive value in his own unit. In either case his water charge is slowly absorbing his farm investment or this charge is paid at the expense of some other income. Where such conditions exist, the cost of water may be termed a "distressing" cost because it has attached to it a false value which is a factor in keeping otherwise supermarginal farms near the marginal line or lower.

Comparative Value of Operator's Present Irrigation Water to Storage Water

In most instances operators would make about the same effective use from stored water as is now the case with the present supply. Irrigation water is now utilized very efficiently, even during the period of spring run-off when stream discharge is greatest. Under present procedure a larger acreage is irrigated during the season of high water and a gradual reduction in irrigated acreage occurs as the stream discharge decreases. Usually only one or two applications of water are used on grain crops which will produce a fair yield, but irrigation is continued throughout the season on alfalfa which produces two or three crops of hay or one crop of hay and a crop of alfalfa seed.

Although for the average farm operator any additional water will be worth about the same as the present stream flow, undoubtedly there are a few operators who can afford to pay a higher price for storage. This might be true if the additional water were to be used in intensive crop production on a relatively small acreage. Such intensive cropping might tolerate an increased water cost. Opportunities for this type of operation are rather limited. Another example is that of a farm unit which is now well organized, for which the operator wishes supplemental water for increased irrigation of a relatively small acreage. If development of this small acreage is but a very small percent of total operating expense for the farm unit as a whole, then the operator may be in a position to pay a very high price for a limited amount of water.

Generally speaking, storage water development in Malad Valley will bring about very little change in type of farming or effective use of water on the average farm. As water is the limiting factor in this area, the most productive combination in yield between land and water is not maximum production

per acre but maximum yield per farm, or maximum income per dollar of investment. The shortage of water in proportion to land creates need for highest efficiency in water use. This will be attained with an amount of water which is much less than that required to produce greatest per acre crop yield. For this reason the acreage put under maximum production is small and limited in this valley. Where stream flow has about the same effective use as storage water, as is the case here, their acre foot value should be approximately the same.

Permissible Cost Which Operators Can Afford to Pay for Water

Assuming that stream flow has about the same effective use as stored irrigation water would have, the permissible cost to operators for storage development should be proportional to the value of stream flow. If pumped groundwater is selling for approximately $2.50 per acre foot it appears that this amount is about the upper permissible cost limit for storage water development.

On the basis of $2.50 per acre foot the Samaria Irrigation Company could pay $3,500 annually for 1,400 acre feet. This amount includes capital cost, interest and all other charges. In this instance additional operation and maintenance charge would be negligible. If repayment were on an amortized basis of three percent covering a 20 year period it would provide for a total construction cost of about $36.00 per acre foot and a total capital cost of $50.00 per acre foot. The total capital cost per acre foot which would be amortized at 3 percent may vary from $30 per acre foot for a 15 year loan to $55 per acre foot for a 40 year loan. If interest were granted, the amount that could be repaid over a 40 year period would be $100 per acre foot.

As the amount these water users can pay, an annual payment based on the figure $2.50 per acre foot of storage is given as the best estimate possible

from available data. This figure is given as a guide to the upper limit rather than the lower limit of permissible cost. The purpose of the project will be better served if the annual payment can be reduced below this amount through providing a longer period of repayment. It should not, however, be reduced by grant or subsidy, except to the amount that it is later conclusively shown by the water users or by detail study that it exceeds the cash annual value of the service of the facility to the users.

Public Values

In any facility for the conservation and better use of the basic resource of water, there is a considerable indirect public value in addition to the direct value to the water users. This value is made up of such intangible factors as better use of land and consequent conservation of the soil, social and economic value to the whole county in higher individual and community standards of living, etc. In this particular case there is a direct general public benefit in the increased supply to the groundwater.

These public values are measurable only in broad terms of public policy. That they are recognized is indicated by the terms of the Water Facilities Act. It is further indicated by the established national policy of reclamation in which the public participates through the grant of interest on public funds advanced for such development.

The present proposal presents the various elements of public value to a high degree. It will make available for use, water not wasted. It will make this use available on the higher lands of the valley, leaving full opportunity for re-use. It will provide a most important factor in maintaining and continuing a stable prosperity in this community. It is believed, therefore, that

some grant of public funds will be justified if that is necessary to bring the cost within the amount which can be repaid without distress.

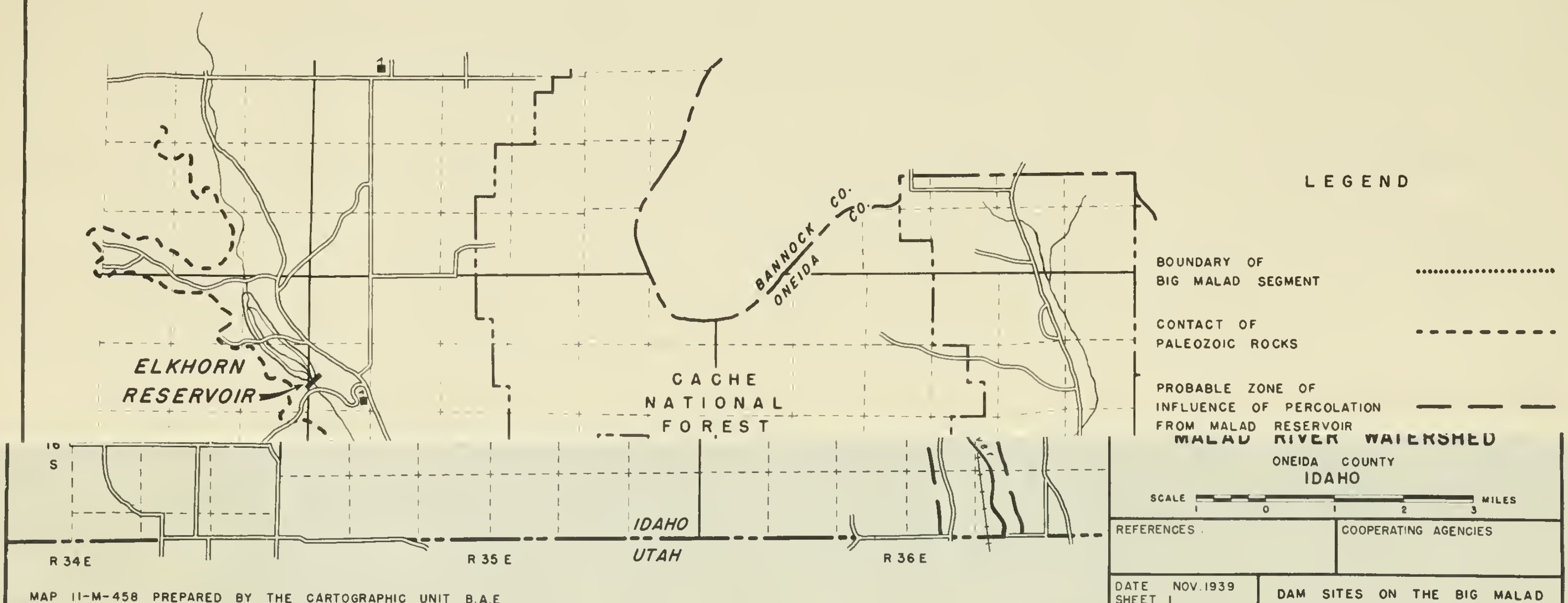
As previously noted, the cost of the proposed structure has been estimated at $44,000, while capital amount that might be repaid is indicated at approximately $50,000. It is recognized however, that, through unforseen contingencies the eventual cost might be increased. It is further recognized that the water users may show that repayment ability is slightly less, or available terms of loan may decrease capital amount in relation to annual payment below the ratio herein assumed. The relatively small percentage of public participation that operation of either or both of these contingencies might make necessary seems well justified in the prospective public values of this project.

While some of the stockholders of the Samaria Irrigation Company would class as "low income" farmers, the general status of this community does not justify a considerable grant of public funds for the benefit of individuals. Generally in such circumstances, public participation in the construction cost of a facility should be accompanied by permanent public ownership. In this case, however, the water users are furnishing the site of the project and have established the right to impound and use the water. For the small percentage of the total final value that may be represented by public funds it would appear to be out of proportion to suggest public ownership. This is especially true, as such public ownership has not as yet become a recognized policy.

MAP I

MALAD RIVER WATERSHED—IDAHO

DAM SITES ON THE BIG MALAD



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